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Foreign Bodies and Bowel Obstructions

Jessica Elizabeth Taylor and Devin Clegg

Abstract

Foreign body ingestion most commonly occurs in the pediatric population, with approximately 80–90% of objects passing spontaneously in individuals who are evaluated by medical professionals. Objects may be lodged in a variety of anatomic locations. Only about 10% of foreign bodies progress past the stomach. Of the 10–20% of objects that fail to pass, less than 1% requires surgical intervention. Small bowel obstructions are a rare presentation of foreign body ingestions. There are case reports, guidelines, and retrospective reviews in the literature regarding the management of ingested foreign bodies. In patients who do not have spontaneous passage of foreign bodies, endoscopic and surgical techniques have been utilized for successful retrieval. The timing and indication for endoscopic intervention is dependent upon several factors, including the type and location of the foreign body and is also contingent upon patient symptoms. Numerous case reports and studies describe the successful endoscopic removal of foreign bodies in the upper and lower gastrointestinal tract. Although the type and location of an ingested object is critical for determining the success of endoscopic intervention, the patient's clinical exam and stability is also an aspect to consider when deciding on management of bowel obstructions caused by foreign bodies.

Keywords: foreign body, ingestion, obstruction, intestine, bowel

1. Introduction

Foreign body ingestion encompasses a wide range of objects. Most often, the patients that have ingested a foreign body are in the pediatric population, which can lead to its own challenges in management. In adults, there is even less literature that discusses foreign body ingestion and outcomes.

Foreign bodies can become lodged in various areas of the upper and lower gastrointestinal tracts. There are specific characteristics of objects and certain anatomic and physiologic regions of the gastrointestinal tract that create unique problems regarding management of the ingested foreign body. As is demonstrated in the pediatric literature, an algorithmic approach should be utilized to manage adults who have ingested an object. This approach includes systematic evaluation and work-up, determining appropriate management based on the clinical evaluation, and ultimately addressing complications as they may arise during the management process.

2. Evaluation and work-up

2.1 Clinical history

A very important aspect in the evaluation of foreign body ingestion is obtaining an accurate history. Whether the patient is pediatric or adult, if there was a witness to the ingestion, then determining the exact foreign body and its characteristics will be easier to determine. Adult ingestions, like pediatric, may be intentional or unintentional. Most adult foreign body ingestions occur in patients with developmental delay, elderly individuals, and prisoners seeking a secondary gain [1]. In these patients obtaining a history may be more challenging. The primary information that needs to be gathered during the history of present illness is type of foreign body, when it was ingested, and the onset of any associated symptoms [1]. When the clinician can determine characteristics about the type of foreign body, then it makes the decision on whether to pursue further diagnostic work-up less challenging.

Foreign bodies may be classified into several categories. **Table 1** lists the categories most often ingested. In the pediatric population, household objects are the most commonly ingested, which include coins, toys, jewelry, magnets, and batteries [1]. Following foreign body ingestion, children may present with symptoms immediately. In adults, objects such as partial dentures, razor blades, and toothbrushes have been reported as being ingested [2]. The size of the ingested objects impacts if these foreign bodies will become lodged and unable to pass through the gastrointestinal tract; although, it is reported in the literature that 80–90% of ingested foreign bodies pass spontaneously [3].

The European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guidelines recommend that diagnostic evaluation be considered based on the patient’s history and symptoms. The symptoms that would indicate the presence of an esophageal foreign body include dysphagia, odynophagia, or chest pain. Other symptoms that may also be present include sore throat and vomiting. If the foreign body located in the esophagus is large, it may also cause respiratory symptoms due to compression on the trachea [1]. When the ingested foreign body has migrated through the esophagus patients may not report any symptoms.

Aspects of the patient’s history that may be underappreciated include past medical problems and surgical procedures. When taking an adequate history, it is important to elucidate whether the patient has a history of inflammatory bowel disease or known malignancies that could impact the passage of the foreign body. Disease processes such as Crohn’s or colon cancer could cause stricturing or narrowing in the gastrointestinal tract which may predispose the ingested foreign body to cause an obstruction or other complication. The past surgical history is also important to document, as past abdominal procedures could have altered the anatomy and created additional areas of narrowing which may inhibit the object from passing without complication. After obtaining a thorough history from the patient or other witnesses, then it is appropriate to proceed to physical examination.

Ingested foreign body classifications
Blunt
Sharp
Long

Table 1.
Foreign body classifications.

2.2 Physical examination

The importance of the physical examination should not be underestimated when evaluating a patient with a suspected foreign body ingestion. Although the esophagus is the most common location for a foreign body to become lodged, once it passes into the stomach there are anatomic areas where it has a higher risk of causing obvious signs on physical examination. If the object fails to pass through the esophagus, there may be obvious findings on physical exam such as choking, stridor, or dyspnea, which may be due to aspiration of saliva [1]. In contrast, if the object becomes lodged in the stomach, then the patient may present with abdominal tenderness and distension with associated symptoms of nausea and vomiting. The small intestine, specifically at the ileocecal valve, is another location where a foreign body may cause physical exam findings consistent with obstruction.

The gastrointestinal tract has several anatomic areas of narrowing, which are listed in **Table 2**. One physiological angulation that has been reported to cause difficulty in allowing foreign bodies to pass is the duodenal sweep. If an object is lodged in one of these areas pain may be present on physical exam or as a presenting symptom.

The areas of interest with regards to intestinal obstructions or complications include the ileocecal valve, anus, and duodenal sweep. If the patient has undergone prior operative procedures, in addition to the anatomic areas of narrowing, adhesions or alterations in intestinal anatomy may impact the passage of an ingested foreign body. Examining the abdomen for previous scars and evidence of surgical procedures should be carefully performed, especially in patients who are unable to communicate their past medical and surgical histories.

In patients who present with possible complications related to foreign body ingestion, physical exam findings may be more concerning. Patients with a perforation due to ingested foreign body may have vitals and exam findings which include tachycardia, fever, and peritonitis [1]. If the decision is made to admit and observe a patient who has ingested a foreign body, then monitoring vitals and serial exams becomes an important part in management.

2.3 Diagnostic work-up

Following a thorough history and physical examination, diagnostic work-up should be initiated based on the information gathered from the patient. The diagnostic work-up can include labs and imaging. The imaging techniques discussed in the literature ranges from plain X-rays to CT scans.

Anatomic areas of narrowing in gastrointestinal tract
Upper esophageal sphincter
Aortic arch
Left main stem bronchus
Lower esophageal sphincter
Pylorus
Ileocecal valve
Anus

Table 2.
Anatomic narrowing of GI tract.

Once it is established that a patient has ingested a foreign body, the initial imaging recommended by ESGE is plain X-ray evaluation of the neck, chest, or abdomen depending on the information obtained from the history. The purpose of the imaging is to determine several key pieces of information. Plain films are useful in establishing, initially, the actual presence of a foreign body. Second, X-rays can also provide an estimation as to the size and location. If multiple objects are suspected of being ingested, such as magnets, then the imaging can also help determine the number of foreign bodies [1]. Additionally, complications such perforation or obstruction may also be detected on initial plain films.

Other reports in the literature have discussed using serial X-rays to evaluate passage of objects, specifically magnets in the pediatric population. The protocol suggested by the North American Societies of Pediatric Gastroenterology, Hepatology, and Nutrition includes obtaining serial X-rays every 4–6 hours to monitor for progression [4]. Although obtaining serial abdominal films is considered a diagnostic study, it is also concurrently a part of the non-operative management of foreign body ingestion.

Despite plain radiographs being recommended as the initial diagnostic imaging, there is a reported false-negative rate of 47% [1]. Common objects that are not easily visualized on X-rays include wood, chicken bones, glass, and plastic [1]. If an adequate history supports the ingestion of an object that is difficult to visualize on initial work-up, then further imaging should be performed. Most literature supports that if a complication of foreign body ingestion is suspected, such as perforation or obstruction, then CT scan is the imaging of choice to perform for further evaluation [1].

Figure 1 shows a CT scan obtained in the emergency department on a patient with mental disability and history of PICA. The patient was unable to provide a



Figure 1. CT scan demonstrating small bowel obstruction caused by foreign body. Black arrow represents foreign body and white arrow demonstrates patient's functional gastrostomy tube.

history, but per her caregivers she was noted to have increasing abdominal distension and blood coming from her ostomy. Review of the CT scan demonstrated a foreign body causing an obstruction at the ileocecal valve.

Some literature in the pediatric population supports the use of ultrasound in evaluating foreign bodies in the gastrointestinal tract. One published case series showed that different sizes and types of ingested objects can be visualized using point-of-care ultrasound. Other parts of the study demonstrated that ultrasound can also be used to locate foreign bodies within the gastrointestinal tract as well as look for signs of bowel obstruction. Overall, the literature is lacking with regards to ultrasound use in foreign body ingestion, and further studies should be conducted to determine if it is an appropriate substitute for X-ray imaging when evaluating ingested foreign bodies [5].

3. Management

3.1 Important considerations

The literature describing intestinal obstructions due to foreign bodies is replete with case reports, citing many different strategies that are unique based on patient, location, time course and object type, as well as facility resources. More than 100,000 foreign body ingestions are reported each year, with estimated mortality rates around 3% [6]. As previously mentioned, foreign body ingestion is most common in the pediatric population with the peak incidence between ages 6 months and 6 years [7]. This can also be encountered frequently by the general surgeon in the adult population. While the management of foreign bodies is generally well described when located in the upper gastrointestinal (GI) tract, those that pass beyond the gastroesophageal junction and eventually into the lower GI tract are less well documented. While considering the management of these patients, you must consider that between 80 and 95% of objects that traverse the gastroesophageal junction pass through the gastrointestinal tract without further complication, in both pediatrics and adults [6, 8]. Ingestions of foreign bodies or impacted food can lead to the need for emergency endoscopic intervention in 10–20% of cases, with only about 10% of foreign bodies progressing past the stomach, and only 1% requiring surgical intervention [6, 9]. While up to 80% of total foreign body ingestions occur in pediatric patients, in the adult population true foreign body ingestion of nonfood objects more commonly occurs in those with psychiatric illnesses and developmental delay [10].

3.2 Initial management

With all foreign body ingestions, or in rare cases, migrations, the clinician must decide whether the intervention is warranted, the degree of urgency needed, and by what approach. Initial management of foreign body ingestion is first concerned with discerning signs and symptoms of airway compression as these patients may need a definitive airway with endotracheal intubation or other adjuncts. Asymptomatic patients can often describe what or how the object or foreign body was ingested which will aid in determining course of treatment. Patients who have passed the foreign object beyond the gastroesophageal junction or into the distal gastrointestinal tract may present with signs and symptoms of obstruction or perforation. This includes abdominal pain, fever, vomiting or peritonitis [8]. Patients presenting with these symptoms often undergo imaging initially and in rare cases, can present with obstruction or perforation secondary to previously placed surgical materials [6, 11, 12]. Abdominal plain films can be used to follow most radiopaque

objects, but CT scan is recommended to delineate more detail. Patients with known foreign body ingestion can be expectantly managed with serial abdominal exams or serial imaging as most foreign bodies that have passed through the esophagus will be excreted without further injury. This is true even for sharp-pointed objects, despite an increased risk of perforation [7].

Impaction, perforation, or obstruction occurs most often at areas of acute angulation or narrowing such as the level of the cricopharyngeus muscle and the ileocecal valve. Other areas of concern, specifically with longer shaped objects, include the pylorus and duodenal c-loop [6]. Patients with prior GI tract surgery or congenitally malformed guts are at increased risk for obstruction and perforation and should be considered for intervention with any change in abdominal exam or imaging [7]. In addition to the signs and symptoms of perforation or obstruction, persistence of an asymptomatic foreign body in the stomach can be a relative indication for endoscopic retrieval, and those lodged distal to the stomach in a fixed persistent location for longer than 1 week may warrant operative intervention [8]. It has been suggested that the time required to excrete a foreign body is between 4 and 6 days, and rarely up to 4 weeks, with retention time in the duodenum being particularly important. If the object is retained in the duodenum for longer than 7 days, it has been shown to have an increased risk of perforation [9]. Gastrointestinal perforation requires emergent operative intervention, with bowel perforation often managed with an open approach, but can be considered for a laparoscopic approach depending on surgeon comfort and availability.

3.3 Endoscopic management

Urgent endoscopic management is often necessary when foreign body ingestion results in impaction within the esophagus, especially when the object is sharp or a button battery. It is also required to prevent aspiration when the foreign object or food bolus impaction creates a high-grade obstruction causing difficulty in managing secretions. Rigid and flexible esophagoscopy are both effective and safe methods of intervention for the removal of esophageal foreign bodies [7]. As rigid esophagoscopy requires general anesthesia, use of a flexible scope may be more feasible in certain situations.

Foreign objects that traverse the pylorus and are located in the distal gastrointestinal tract can still be retrieved endoscopically in certain situations. Single and double-balloon enteroscopy (DBE) can access the small intestine and is emerging as a reliable method of retrieval based on operator comfort and availability [9]. Accessories for the treatment of foreign bodies such as hoods, baskets and forceps have been designed for enteroscopes. Case reports have described the successful retrieval of retained video capsules [3, 12]. Asymptomatic patients are more likely to be candidates for endoscopic management, but case reports have described successful retrieval of retained objects at risk for obstruction or perforation [3]. As DBE is minimally invasive, it theoretically should decrease the length of hospitalization when compared with laparotomy and laparoscopy, although a study has not been specifically performed for this purpose.

The patient whose CT scan was shown in **Figure 1** underwent colonoscopy in an attempt to obtain the foreign body. **Figure 2** demonstrates the endoscopic retrieval of a gastrostomy tube that was causing an obstruction at the terminal ileum. The patient had ingested the feeding tube, and it migrated through the gastrointestinal tract until becoming lodged in the small bowel.

Other forms of lower endoscopy can also be considered based on object location and patient characteristics and include the use of a colonoscope. Endoscopic guidelines have been published more extensively but pertain particularly to the

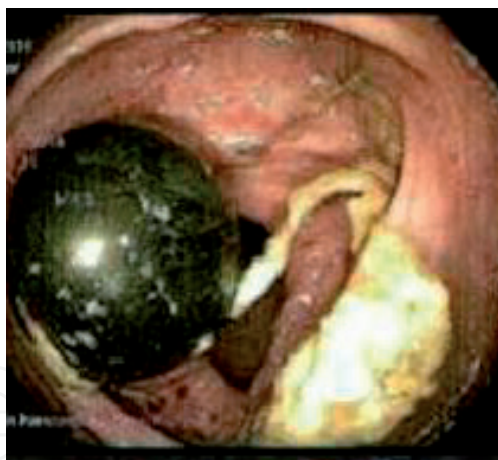


Figure 2.
Colonoscopy showing retrieval of foreign body.

management of the upper gastrointestinal tract, and in the pediatric population [3, 7, 8, 13]. Guidelines for the management of foreign bodies in the lower gastrointestinal tract likely require more data and studies to be performed prior to formal recommendations. At this time, management is trending strongly towards the use of endoscopy for stable patients, while unstable patients or those at high-risk for perforation are managed operatively.

3.4 Surgical management

Surgical management is often reserved for patients that present emergently with bowel obstruction, abscess formation, or perforation secondary to the foreign body ingestion. These patients have traditionally undergone open procedures as a first choice, but with advances in technique and availability, laparoscopic approaches are being more commonly reported as a successful alternative.

3.5 Laparoscopic management

Laparoscopy is an important method to consider when approaching the management of patients with retained foreign objects in the distal gastrointestinal tract. The trend towards minimally invasive surgery has been supported by decreased length of hospitalization and a lower rate of complication in abdominal surgery when compared to laparotomy. The use of this method largely depends on surgeon comfort, training and availability, as many facilities defer to laparotomy for management due to these limiting factors.

Most of the information on laparoscopic management of intestinal obstructions related to foreign body ingestion is anecdotal, with few studies being performed to date. A five-patient case series from Chia et al. reported successful management with laparoscopy after failed endoscopy. Three of five patients had abscess formation, with two patients complicated by perforation. All five had successful retrieval of the foreign body and primary repair of the bowel with intracorporeal suturing, as well as successful deroofting and drainage of the abscesses if needed [14]. Other case reports have reported similar methods and results, with some describing enterotomy and intracorporeal repair after retrieval [11, 15].

It is important to note, that with any surgical intervention performed, it is recommended that any potentially involved bowel be visualized for perforation or injury. As with all bowel injuries, if greater than 50% of its circumference, resection and anastomosis is recommended.

3.6 Open surgical management

Laparotomy is still recommended for management of the unstable patient with suspected or confirmed perforation or obstruction that is threatening life or bowel. This presentation secondary to foreign body obstruction is rare, but it is important to consider. As the management trend has shifted towards minimally invasive, with endoscopic management often attempted first and laparoscopy considered if available, open surgical management is often reserved for emergency or for those facilities that do not have the resources the previously mentioned approaches [8, 9, 16, 17]. As with the laparoscopic management, the area of obstruction, perforation or abscess formation should be localized and an enterotomy made for retrieval. If the bowel is viable and can be repaired primarily this is recommended. If bowel injury is greater than 50% of its circumference, resection and anastomosis is recommended. If the patient is unstable and requires further resuscitation, or the abdomen is grossly contaminated, damage control surgery is always a consideration with the patient left in discontinuity after the object has been removed and further contamination has been controlled.

Intervention upon retained foreign object is largely dependent on the characteristics of the patient, the object, the time course and the presentation, as well as the resources available at the facility. As the majority of foreign objects pass without injury through the gastrointestinal tract, it is relatively rare for ingestion to result in surgical intervention. A clear trend towards the most minimally invasive approach has been forming, and we anticipate that the future guidelines will reflect this. The basic principles of bowel obstruction and perforation are still the most important factors to consider when planning your method of management and should be adhered to.

4. Complications

4.1 Perforation

Foreign body ingestion resulting in perforation is a rare but dreaded complication. It is reported to occur following only 1% of foreign body ingestions [18]. Some studies in the literature report that the average time from ingestion to evaluation at a medical facility was 10.4 ± 9.3 days with a wide range of 3 to 60 days [19]. The most common presenting symptom at the time of presentation is abdominal pain, with many patients having peritonitis on exam. Once a diagnosis of perforation is suspected, operative exploration is warranted. The most common locations found intra-operatively are the distal ileum and colon. Other less common locations are the duodenum and jejunum. Reports in the literature support that longer objects often result in more proximal intestinal perforation at the second and third portion of the duodenum as foreign bodies are unable to pass through the physiological angulation [20].

Although emergent surgical intervention is often the first line treatment for perforation, there are case reports in the literature that discuss endoscopic management [18]. Simunic et al. discussed the successful endoscopic retrieval of a sharp foreign body from the cecum that caused a localized perforation [18]. Their report emphasizes that clinically stable patients with localized findings on CT scan are more likely to be successfully managed using this technique. Despite case reports discussing the management of localized perforations, foreign body ingestions that present as perforations do not usually manifest with minimal symptoms and clinical stability. Consideration of endoscopic management should be on a case by

case basis if the appropriate qualified personnel are available to assist in treatment. Overall, surgical treatment is still the recommended course of treatment for such complications.

4.2 Obstruction

The literature regarding foreign body ingestion causing obstruction is relatively limited to case series at single institutions and published case reports. Review of the available literature supports that intestinal perforation is the most common presenting complication with obstruction being the second most frequently encountered [21].

As mentioned previously, delayed presentation following foreign body ingestion increases the risks for complications, such as intestinal obstruction. In patients who present in a delayed fashion after ingestion of superabsorbent polymers, as the time increases following ingestion, both the length of passage and amount of water absorbed by the foreign body increases. These factors increase the likelihood of intestinal obstruction and decrease the chance that the foreign body will pass without either endoscopic or surgical intervention [2]. The key to preventing intestinal obstruction is to pursue endoscopic intervention early when ingestion is highly suspected but not witnessed. If obstruction is not identified in a timely fashion, then it can lead to intestinal perforation, which has its own associated morbidity.

4.3 Bleeding

Most complications reported in the literature associated with foreign body ingestion are related to perforation, obstruction, or fistula formation. Bleeding is another complication that can result from foreign body ingestion. Hemorrhage can result from direct mucosal injury from sharp objects. Bleeding may also occur due to erosion of the mucosa caused by blunt objects. In patients who are hemodynamically stable and present with gastrointestinal bleeding with a history of foreign body ingestion, endoscopic intervention should be considered not only as a diagnostic tool but also as potentially therapeutic.

The ESGE recommends that endoscopy be performed within 24 hours for sharp and long objects that are in the stomach to prevent complications such as bleeding, perforation, and obstruction. In the pediatric population it is well documented that button batteries, if ingested, may lead to all the above complications [1]. Although, they are most commonly lodged in the esophagus, if they do pass into the stomach and then into the small intestine, they may cause obstruction leading to mucosal erosion and subsequently perforation. A patient may present with hematemesis or lower GI bleed depending on where the object is causing mucosal erosion. It is estimated that the risk of complications can be as high as 35% once these objects leave the stomach [1]. With regards to adult literature, case reports have been published showing that ingestion of sharp foreign bodies can cause life-threatening gastrointestinal bleeding. Gattai et al. reported on a patient who had ingested glass, which caused lacerations in the fourth portion of the duodenum that led to a severe gastrointestinal bleed. During operative intervention the patient was found to have a segment of jejunal diverticulum; however, the source of bleeding was not found in the resected portion of bowel. Following small bowel resection, the patient continued to hemorrhage and was found to have active bleeding from lacerations found in the duodenum. This case report demonstrates the severity of foreign body ingestion and appropriate surgical management [22]. If bleeding is unable to be controlled endoscopically, then surgical intervention is mandated. Although gastrointestinal hemorrhage is a rare complication, its morbidity should not be underestimated.

5. Special considerations

Bezoars are uncommon masses formed from indigestible ingested substances in the gastrointestinal system. They were named in 1854 by Quain, after a mass of intragastric food residue was found during autopsy [23]. They are reported to contribute to up to 4% of small bowel obstructions [23–25]. Many are diagnosed post-operatively as they do not have a clinically significant difference in presentation from other causes of small bowel obstruction [24]. There are different forms of bezoars that are classified based on the content that forms the mass.

5.1 Classification

There are five types of bezoars: phytobezoars, trichobezoars, polybezors, pharmacobezoars, and lactobezoars [23, 25]. Phytobezoars are made of vegetable and fruit residues, trichobezoars consist of hair, a lactobezoar is formed from dairy products, polybezors are caused by ingested foreign bodies, and a pharmacobezoar is caused by medications [23]. The most common type of bezoar is the phytobezoar, which typically consists of cellulose and hemicellulose from indigestible food residue [23]. Trichobezoars are generally seen in individuals with trichophagia, a psychiatric disorder that causes the compulsive eating of hair after pulling (trichotillomania), usually seen in young adults and during childhood [23, 26, 27]. Most cases of trichobezoars are reported in females, which may be attributed to the tendency to have longer hair [26]. These bezoars are generally located in the stomach, but prolonged or unrecognized ingestion can cause a process known as Rapunzel syndrome, where the hair extends from the stomach into the small intestine [23, 26, 27]. Treatment of the underlying psychiatric illness is paramount to prevent recurrence and further complication. Trichobezoar with Rapunzel syndrome is an uncommon diagnosis in children, with fewer than 100 cases reported [26].

5.2 Presentation

The symptoms of bezoars can differ according to size, location and the level of obstruction. Gastric bezoars will usually present with vomiting, upper abdominal pain and distention, which are common symptoms of obstruction [23, 24]. The most common symptom has been reported as upper abdominal pain [24]. It is often difficult to differentiate small bowel obstruction (SBO) secondary to bezoar from adhesive obstruction in a patient who has had previous abdominal surgery.

The history portion of the clinical exam is often the most important in this patient population as past surgical history and medical conditions can raise suspicion for a bezoar. Predisposing factors of bowel obstruction due to bezoar are ingestion of a high-fiber diet, abnormal chewing, diminished gastric secretion and motility, diabetics, patients with myotonic dystrophy and many other less common factors [23–25]. High-fiber foods such as celery, pumpkins, grape skins, prunes and especially persimmons, are a risk factor for formation [23]. Bezoars are prevalent among patients with delayed gastric emptying such as after a gastrectomy or a vagotomy, or secondary to diabetic autonomic neuropathy and hypothyroidism [23–25]. Bezoar causing SBO in patients with previous gastric surgery is well known as a late complication, although rare [25]. Incidence of post-gastrectomy bezoar has been reported to be between 5 and 15%, and the time it takes a bezoar to form after gastric surgery ranges from 9 months to 30 years [23, 25]. Bezoars can also be formed primarily in the small intestine when a mechanical factor alters the small intestinal lumen such as a diverticulum, tumor or stricture [23]. Pharmacobezoars are usually caused by Kayexalate (sodium polystyrene sulfonate), cholestyramine

and antacid medications [23]. Lactobezoars typically occur in low-birth-weight newborns as a result of concentrated baby formulas [23].

An accurate preoperative diagnosis is often difficult due to lack of specific symptoms, and clinical presentation of an acute surgical abdomen is very rare, occurring in 1.1% of cases [24, 25]. Most bezoars in the small bowel are found approximately 50 to 70 cm above the ileocecal valve because of narrowing with slower intestinal motility and significant water absorption that hardens the bezoar [24]. The most common site of obstruction is the terminal ileum [25].

5.3 Imaging

Computed-tomography is the gold standard imaging modality for diagnosing small bowel obstruction due to bezoar [23, 24]. Contrast-enhanced CT imaging is the most valuable method for determining the location and etiology of intestinal obstructions [23]. The history provided by the patient in conjunction with CT imaging findings will likely give the most complete picture. As many bezoars can be radiolucent, plain film radiographs may have less utility. Other imaging modalities that can be considered are abdominal ultrasound, which has a reportedly high diagnostic rate of 88–93%, but this is user dependent and can be limited by patient's body habitus, gas accumulation and location of the obstruction [24].

5.4 Treatment

Treatment is identical to that previously described for other forms of small bowel obstruction due to foreign body ingestion. The minimally invasive approach of endoscopy, including double-balloon enteroscopy, may be used as a first line if the patient is stable without perforation. Case reports have described the use of endoscopic fragmentation, gastric lavage, enzymatic therapy or combination of these approaches [26, 27]. Bezoars like Rapunzel syndrome require surgical removal. Laparoscopic enterotomy and retrieval should be considered for any obstructions not amenable to endoscopic treatment. Open surgical management should be reserved for patients in extremis, with perforation and contamination, or based on the availability of experienced endoscopic and laparoscopic surgeons and resources.

6. Conclusions

Foreign body ingestion can be a challenge to manage. It creates diagnostic as well as treatment dilemmas for clinicians. Evaluation should be initiated with a basic history and physical exam, and further imaging studies should be obtained based on the information gathered. After appropriate work-up has been completed, clinicians can determine the next step in management. Most foreign body ingestions may be managed non-operatively; however, in some situations, management may be a multidisciplinary approach that includes gastroenterologists and surgeons. Ultimately, the patient's clinical stability and examination should determine the best course in management to prevent complications associated with foreign body ingestion.

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Conflict of interest

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